REPORT

Issued by an Accredited Testing Laboratory

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AB Ludvig Svensson
51182 KINNA

Reaction to fire tests – Part 1: Heat release rate (cone calorimeter method) according to ISO 5660-1

(3 appendices)

Introduction

RISE has by request of AB Ludvig Svensson performed a fire test according to ISO 5660-1. The purpose of the test is to form a basis for reaction to fire classification according to EN 45545-2:2013+A1:2015 and EN 45545-2:2020.

Product

According to the client: upholstery fabric called “Mingel”, consisting of 100 % Trevira CS. The product has a nominal thickness of 1.0 – 1.2 mm, a nominal area weight of 450 g/m^2, and the colour is black/grey. A photograph of the tested product is shown in appendix 2.

According to the standard EN 45545-2, table 2, the product is defined as a “Listed Product” to which the following parameters apply:

Product No:	INF1A
Location:	Interior
Description:	Furniture
Product name:	Upholstery for passanger seats and head rest
Requirement Set:	R21

Manufacturer

AB Ludvig Svensson, Kinna, Sweden.

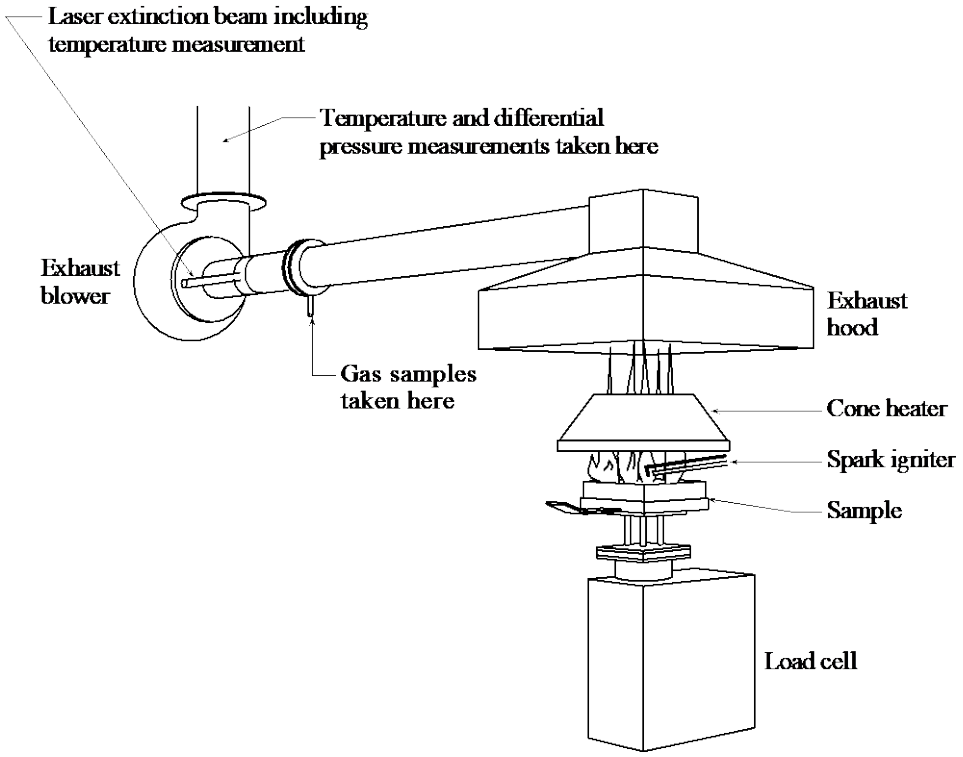
Sampling

The sample was delivered by the client. It is not known to RISE, Fire and Safety if the product received is representative of the mean production characteristics. The sample was received on November 23, 2022 at RISE, Fire and Safety.

Test procedure

The specimen is placed horizontally and exposed to a constant irradiance level of 25 kW/m^2. The specimen surface is heated and pyrolysis gases are formed, an external spark ignites the pyrolysis gases. The gases are collected by a hood and extracted by an exhaust fan. The heat release rate (HRR) is determined by measurements of the oxygen consumption derived from

the oxygen concentration and the flow rate in the exhaust duct. During the test a retainer frame of steel covers the edges and periphery of the specimen.



Schematic drawing of the Cone calorimeter, ISO 5660-1.

Test results

A summary of the test results is shown in the table below. Detailed test results are given in appendix 1. A photograph of a specimen of the tested product is shown in appendix 2. A test results explanation is given in appendix 3.

Mean value for MARHE (kW/m^2) (triplicate tests)
26

The test results relate only to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

Classification criteria

According to EN 45545-2 table 5, requirement set No. R21, classification criteria regarding test results from test according to ISO 5660-1 are tabulated below.

In order to achieve reaction to fire classification according to EN 45545-2, the product should be tested according to several test methods listed by requirement set No. R21.

Test method, Parameter (Unit)	Requirement Definition	HL1	HL2	HL3
ISO 5660-1: 25 kW/m^2, MARHE (kW/m^2)	Maximum	75	50	50

Note

The accreditation referred to is valid for ISO 5660-1.

The smoke production data as described by the standard is not presented in this report.

A reported result is compliant if it is equal to the requirement after rounding to the specified requirement level plus one digit.

According to EN 45545-2 the end-use material combination should be tested. In this case, only the cover fabric of a passenger seat has been tested together with a standardized non-combustible substrate as described by ISO 5660-1.

RISE Research Institutes of Sweden AB
Fire and safety - Reaction to Fire Medium Scale Lab

Performed by

Susanne Blomqvist

Examined by

Per Thureson

Appendices

1. Test results
2. Photograph of a specimen of the tested product
3. Test results explanation

Laboratory approved by CERTIFER Railway Certification

Appendix 1

Test results ISO 5660-1:2015/AMD 1:2019

Product

According to the client: upholstery fabric called “Mingel”, consisting of 100 % Trevira CS. The product has a nominal thickness of 1.0 – 1.2 mm, a nominal area weight of 450 g/m^2, and the colour is black/grey.

Test specification

Irradiance level:	25 kW/m^2.
Calibration constant (C):	Test no. 1, 0.04236 $m^{1/2}\,g^{1/2}\,K^{1/2}$. Test no. 2 and 3, 0.04249 $m^{1/2}\,g^{1/2}\,K^{1/2}$.
Orientation:	Horizontal.
The exposed surface area of test specimen:	0.009 m^2. The retainer frame was used.
Backing:	No other than the non-combustible required in the standard.
Specimen mounting:	Mounting according to EN 45545-2:2013+A1:2015, appendix D and according to EN 45545-2:2020, appendix A. The wire grid was used during the test to avoid distortion of the specimen.
Radiator cone location:	The radiator cone was located so that the lower rim of the radiator cone shade junction was 25 mm above the upper surface of the specimen when oriented in the horizontal position.

Appendix 1

Test results

Property	Name of variable	Test 1	Test 2	Test 3	Average value
Flashing (min:s)	t_{flash}	02:01	-	-	-
Ignition (min:s)	t_{ign}	02:16	02:43	02:51	02:37
All flaming ceased (min:s)	t_{ext}	03:11	03:47	04:44	03:54
Test time (min:s)	t_{test}	20:00	20:00	20:00	20:00
Heat release rate (kW/m^2)	q	See figure 1	See figure 1	See figure 1	
Peak heat release rate (kW/m^2)	q_{max}	187	298	156	214
Average heat release, 3 min (kW/m^2)	q_{180}	21*	29	33*	28
Average heat release, 5 min (kW/m^2)	q_{300}	10	16	23	16
Total heat produced (MJ/m^2)	THR	4.4	5.7	12.9	7.6
Sample mass before test (g)	M_0	4.9	4.9	5.0	4.9
Sample mass at sustained flaming (g)	M_s	4.4	4.3	4.1	4.3
Sample mass after test (g)	M_f	0.8	0.0	0.8	0.5
Average mass loss rate (g/m^{2}s)	$MLR_{ign-end}$	0.4	0.4	0.4	0.4
Average mass loss rate (g/m^{2}s)	MLR_{10-90}	10.2	22.2	3.1	11.8
Total mass loss (g/m^2)	TML	384	444	384	404
Effective heat of combustion (MJ/kg)	ΔH_c	11.4	12.8	-	12.1**
Max average rate of heat emission (kW/m^2)	MARHE	25.2	28.1	23.7	25.7
Volume flow in exhaust duct (l/s)	V	24	24	24	24

* No retests were done despite the 180s mean heat release rate readings differ by more than 10 % from the arithmetic mean.

**Average based on 2 tests.

Appendix 1

Graphs of heat release rate and smoke production rate

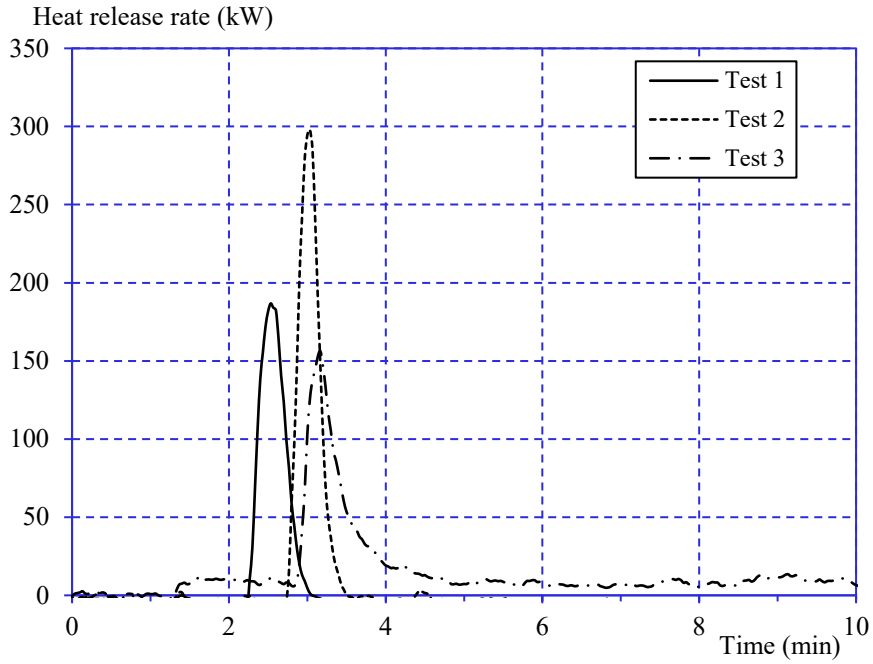


Figure 1 Heat release rate, triplicate tests at an irradiance of 25 kW/m^2.

Measured mass loss

Variable	Test 1	Test 2	Test 3	Average value
Specimens initial weight (g)*	4.9	4.9	5.0	4.9
Specimens final weight (g)*	0.8	0	0.8	0.5
Mass loss (g)	4.1	4.9	4.2	4.4

* Weight includes the specimen wrapping foil.

Measured data

Thickness 1.1 mm approximately.
Area weight 490 - 500 g/m^2.

Conditioning

According to ISO 5660-1.
Temperature (23 ± 2) °C.
Relative humidity (50 ± 5) %.

Operator

Peter Lindqvist and Mohammad Almouaz.

Date of test

Test 1, November 28, 2022.
Test 2 and 3, November 29, 2022

Appendix 2

Photograph of a specimen of the tested product

Photo 1. Specimen called “Mingel”. Specimen dimensions are 100 x 100 [mm].

Appendix 3

Test results explanation – ISO 5660-1

Parameter	Explanation
Test start	The test specimen is subjected to the irradiance and the clock is started.
t_{flash}	Time from test start until flames with shorter duration than 1 s.
t_{ign}	Time from test start until sustained flaming with duration more than 10 s.
T_{ext}	Time from test start until the flames have died out.
End of test	Defined as the time when both, the product has been extinguished for 2 minutes, and the mass loss is less than 150 g/m^2 during 1 minute. According to EN 45545-2, end of test is always at 20 min.
T_{test}	Test time. From test start until end of test.
q_{max}	Peak heat release rate during the entire test.
q_{180}	Average heat release rate during 3 minutes from ignition. If the test is terminated before, the heat release rate is taken as 0 from the end of test.
q_{300}	Average heat release rate during 5 minutes from ignition. If the test is terminated before, the heat release rate is taken as 0 from the end of test.
THR	Total Heat Released from test start until end of test.
M_0	Mass of specimen.
M_s	Mass of specimen at sustained flaming.
M_f	Mass of specimen at the end of the test.
$MLR_{ign-end}$	Mass Loss Rate. Average mass loss rate from ignition until end of test.
MLR_{10-90}	Mass Loss Rate. Average mass loss rate between 10% and 90% of mass loss.
TML	Total mass loss from ignition until end of test.
ΔH_c	Effective heat of combustion calculated as the ratio between total energy released and total mass loss calculated from ignition until end of test.
MARHE	Maximum Average Rate of Heat Emission defined as the maximum of the function (cumulative heat release between t = 0 and time = t) divided by (time = t).
V	Volume flow rate in exhaust duct. Average during the test.

Verification

Transaction 09222115557482923944

Document

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